

AGE OF FRINGE DRIFT IN EASTERN OHIO

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During Pleistocene time or the "Great Ice Age" the surface of much of the United States was greatly modified by a series of ice invasions and by resulting changes in the drainage systems. The order and the effect of these events are still subjects for geological discussion. Yet many facts may be interpreted from a careful study of the deposits and of the marks of erosion left on the old surface. Here, mainly, only Ohio is concerned.

EARLY MAJOR STREAMS

As far as known the original drainage in the Appalachian field in western Pennsylvania, parts of Virginia and North Carolina, most of West Virginia, north-eastern Kentucky, and southern and central Ohio was by two major streams of Teays age, the Pittsburgh and the Teays rivers. The general courses of these old streams are readily traced as they left definite impressions on the old land surface. Here they need be discussed only briefly.

PITTSBURGH RIVER

The basin of the Pittsburgh River was largely that now drained by the Allegheny and the Monongahela rivers and by minor streams of northern West Virginia and of eastern Ohio. In the latter area the western boundary of this old basin is marked by the Flushing escarpment. The course of the Pittsburgh River has been traced rather carefully by many workers.¹ This ancient stream flowed northwestward from its formation by the junction of two rivers at Pittsburgh to Beaver, then northward past Beaver Falls and Wampum to New Castle where the stream was dammed by glacial drift. Beyond this its course is less definite but accumulating data indicate that it flowed on northward to the basin of Lake Erie and then by some course not defined, on to the sea.

TEAYS RIVER

The Teays River, the type stream for this stage of drainage, gathered its headwaters in the Appalachian Mountains and the Piedmont Plateau in Virginia and North Carolina and then flowed northward in the "ridge and valley" terrain to White Sulphur Springs, Virginia. Here this old stream cut through the mountains and plateau to Charleston, West Virginia, then traversed the broad abandoned valley, well outlined, past St. Albans and Barboursville to Huntington. Its course was then down what is now the Ohio Valley to Wheelersburg, Ohio, then it turned northward past Minford, Beaver, Waverly, and Richmondale to Chillicothe where the old bed is buried by both the Illinoian and Wisconsin drifts. Through scattered evidence, but with some assurance, its way is traced northwestward from Chillicothe past Clarksburg, London, Vienna, Springfield, St. Paris, and St. Mary's to the Ohio-Indiana state line near Rockford.²

CHARACTER OF OLD TEAYS STREAMS

The streams of the old Teays System were quite mature. Their gradients were low, the valleys wide, the bordering hills well rounded, and the uplands

¹Traced by Foshay, Chamberlin, Leverett, Hice, Campbell, and Lamb.

²For more definite information see Bulletin 44, Geological Survey of Ohio. Also considerable work has been done on this old waterway in Indiana.

thoroughly dissected. They are readily recognized by their position above the present drainage and commonly by deposits of Minford silt.

EARLY GIACIER

The original drainage cycle, the Teays, was brought to a close by an early glacier, probably continental in extent. As here concerned this ice invasion closed the northward passage of the old Pittsburgh River near New Castle, Pennsylvania. Nearby in eastern Ohio the border of the moraine is rather definitely marked from Section 25, Middleton Township, Columbiana County, westward past Clarkson and Dungannon to Kingston, then more irregularly past Mapleton to North Industry where this older drift is buried by that of Wisconsin age. From the effects on the old Teays streams in central and western Ohio this glacier evidently passed on westward across Ohio and on into Indiana, and probably to the Mississippi Valley. This glacier definitely closed the Pittsburgh River near New Castle, Pennsylvania, and most assuredly the Teays River somewhere in western Ohio. Thus it closed the Teays drainage stage and inaugurated a new cycle. Note also that from the known data this is the first drainage disturbance evident in the area.

This "fringe drift" in eastern Ohio is generally thin, not often more than a few feet in thickness. It appears to be only the remnant of a much thicker sheet, which through long weathering and erosion lost much of its volume and most of the common drift features. The border lacks sharpness and definition, the exact boundary often being difficult to determine. The materials are highly weathered; even the granite boulders are much decayed. In every way this fringe drift shows great age.

DEEP STAGE DRAINAGE

The closing of the old Pittsburgh River and that of the Teays River by this early glacier inaugurated the second system of drainage as the waters from those two basins had to find new outlets to the sea. The second drainage cycle is known as the Deep Stage as the valley floors were cut far below those of the Teays stage and now stand below the levels of the present streams. Due to the damming of the Pittsburgh River near New Castle by this early glacier the waters of this basin were deflected southwestward along a tributary of the old Pittsburgh River and then over a col at Sardis into the basin of the Teays River. Then the combined waters from both basins found passage on westward over the Manchester col to the basin of an old stream near Cincinnati and then on to the Gulf.

In such radical changes the *immense amount of work done* and the *long time required* must be duly considered. Thus a great new valley from Pittsburgh to Cincinnati, at least, was excavated not only deep but wide through the resistant rocks. Some 50 or 60 percent of what is now the Ohio Valley was cut during Deep Stage time, hence of long duration.

The features of the Deep Stage drainage are very evident in all the unglaciated part of Ohio and in some areas stand out prominently. In fact the Teays and Deep Stage features are just as apparent as the drifts. Deep narrow valleys are especially conspicuous throughout the old basin of the Pittsburgh River in Columbiana, Jefferson, Harrison, Belmont, and Monroe counties or in the area east of the Flushing escarpment. In the remainder of the unglaciated part of Ohio the same features are apparent, but owing to the Teays basin being more reduced, show in a somewhat less striking way. Thus all valley in the unglaciated part of Ohio exhibit the Deep Stage influence to a marked degree. The Deep Stage drainage inaugurated by the "fringe drift" was cut entirely before the advent of the Illinoian glacier and from the immense amount of work done certainly extended back through Aftonian time to the Nebraskan glacier.

POMEROY-CINCINNATI RIVER

In part the new major Deep Stage stream, the Pomeroy-Cincinnati River, followed the tributaries of the older streams but through long reaches the Deep Stage erosion cut through highland areas with little regard to the older passageways. Everywhere the new valley was cut far below the Teays levels and it was widened to practically the limits of the present Ohio, about one and one-fourth miles. In fact little work has been done on excavating this valley since Deep Stage time. Now consider in more detail some of the work accomplished and the expanse of time required for such a tremendous task.

At East Liverpool the Deep Stage Pomeroy River was cut some 313 feet below the Teays Stage level, at Toronto 360 feet, at Wellsburg 395 feet, and at Powhatan over 400 feet. From the last place to New Matamoras, over the Sardis col, and through the "long reach," from 400 to 500 feet of shales, sandstones, and limestones were excavated to provide passageway for the new stream. From New Matamoras past Marietta to Point Pleasant the younger Pomeroy River used the trough of the old Teays Stage Marietta River but lowered the floor some 200 feet through massive sandstones, shales, and limestones.

From Point Pleasant to Pomeroy and even on to Huntington the course of the new stream was mainly through the uplands, over cols and along minor valleys of the older Teays system. Hence, through this part of the course of the Pomeroy-Cincinnati River much work, with little aid, was accomplished in carving out a great valley in resistant rocks. At Huntington the old Teays Valley proper was encountered by the Cincinnati River and then this course was used, but not entirely, for the younger waterway.

At Wheelersburg, the old Teays River flowed northward and the Cincinnati westward. The best place known to the writer to make an appraisal of the events of glaciation and those of drainage modifications is from the Sun Hill near Wheelersburg, Ohio. Here the Lexington peneplain, apparently the original land surface and quite evident, stands at an elevation not far from 940 feet. Assuming that the original drainage systems began with the uplifting, by the Appalachian Revolution, of the land surface in late Permian time, then through the long geological ages—Triassic, Jurassic, Cretaceous, and Tertiary—the waterways, such as the Teays, were developed and had reached maturity, that is, the valleys were wide, the uplands thoroughly dissected and the bordering hills well sculptured. Now on Dogwood Ridge near Wheelersburg the rock floor of the old Teays River is present at an elevation close to 650 feet. Hence in four geological ages the Teays River had excavated a valley 290 feet deep ($940 - 650 = 290$) and about $1\frac{1}{4}$ miles in width through Pottsville and Waverly rocks. This then, as a measure, may be taken as the work done by that original stream in four geological ages.

Next consider the work done by the Deep Stage stream. Even considering some elevation of the land surface and of shortening the way to the sea, the work done in excavating the new waterway, the Cincinnati River, was large for at Wheelersburg its floor was eroded 190 feet below that of the Teays ($650 - 460 = 190$) and its valley was widened to $1\frac{1}{4}$ miles. Now the question arises: if it took four geological ages to erode the old Teays waterway, 290 feet deep and $1\frac{1}{4}$ miles wide, how long did it take to carve that of the new Deep Stage stream, 190 feet deep and $1\frac{1}{4}$ miles wide. With this measuring stick and under any consideration the time required to do such an immense amount of work on the Deep Stage stream was long and most assuredly extended back through Aftonian time to the Nebraskan ice invasion. Consider also that this was about the smallest amount of work the new stream was required to do for it had to cut through cols and uplands throughout much of its course.

From here the Cincinnati River cut through the Scioto Col, entered the basin of the old Portsmouth River and then passed on southwestward over the Manchester Col to the basin of an ancient stream near Cincinnati. Much of

this terrain consists of hard sandstones and dense carbonaceous shales, so degradation of the great valley here was no easy task.

In review, considering Ohio alone, the Deep Stage Pomeroy-Cincinnati River was cut over 300 miles in length, far below the levels of the older Teays Stage streams, and on an average over one mile wide. In places the degradation of the course had little or no help from earlier streams. This interglacial period lasted sufficiently long to form most of the valley we now know as the Ohio. Further, the cutting was done through all kinds of rocks such as shales, sandstones, limestone, clays, and coals, many hard, massive, and resistant. Under any consideration the time required was long, measured at least in hundreds of thousands of years, if not in millions.

NEWARK RIVER

Also in this discussion the Newark River of Deep Stage age, must be considered briefly. Its main waterway was cut through several basins of the older streams and its bed was also excavated much deeper. Further, cols were cut away and locally complete new intrenchments were made. Through the action of this early glacier the waters from the north-flowing Dover River, in east central Ohio, were diverted over the divide at Gnadenhutton to the basin of the Cambridge River and then along this and related waterways past Coshocton, Trinway, Frazeyburg, Newark, Canal Winchester, Groveport, Ashville, and Circleville to Chillicothe. At the last place it crossed the old Teays Valley, cut a new channel to Higby, skirted old streams past Waverly, Piketon, and Lucasville to Portsmouth where it united with the master stream, the Cincinnati River.

Again the amount of work done on the Newark River of Deep Stage age was large as may be shown by a few examples. The difference in levels between the older and the newer streams is about 190 feet at Portsmouth, 150 feet at Waverly, 90 feet at Chillicothe, 90 feet at Canal Winchester, 100 feet at Newark, and 100 feet at Newcomerstown. The amount of work done; that is, in digging a new valley 100 feet or more below the older drainageways, locally in excavating complete new channels, in widening the valley much beyond that of the older ones, and in doing this in resistant rocks, required a long, long period of time. It certainly reached back to early Pleistocene times.

A REVIEW OF EVENTS

Let us review the events that have happened so far in glaciation and stream changes in this part of the field.

(1) The original or oldest known drainage in the region was that of Teays Stage time. The chief streams were the Pittsburgh and the Teays rivers.

(2) These streams were dammed by a glacier, probably continental in extent.

(3) Prior to this no stream disturbances have been noted. Hence this glacier was evidently the first or oldest in the region.

(4) Thus this early drift—the “fringe drift” glacier of eastern Ohio—closed the Teays Stage cycle and inaugurated the Deep Stage cycle.

(5) The Deep Stage cycle was of long, long duration as an immense amount of work was done in excavating some 50 to 60 percent of new valleys like that of the Pomeroy-Cincinnati River, now the Ohio, and the Newark River. These waterways were cut deep and wide.

(6) This old drift in eastern Ohio, profoundly weathered indicates an age comparable to that required to cut the Deep Stage streams.

(7) Hence, the glacial invasion and the inauguration of the Deep Stage drainage are events young in Pleistocene time, Nebraskan in age.

ILLINOIAN GLACIER

The next event of importance in this series of changes was the advance of the Illinoian ice sheet into central and western Ohio. This closed the Deep Stage

drainage cycle and opened a new one, the Post-Illinoian. As commonly recognized the boundary of the Illinoian glacier extended in a general way from Ashland County southward past Brinkhaven, New Guilford, Hanover, Gratiot, Sugar Grove, Chillicothe, Bainbridge, and Seaman to the Ohio River at Ripley. At the latter place the ice sheet crossed into Kentucky and by so doing blocked the Deep Stage Cincinnati River and thus inaugurated a new cycle of drainage, here not necessary to describe for this treatise.

Wheelersburg is also a good place to make an appraisal of the work done by both the Illinoian and the Wisconsin ice sheets. The main results from the Illinoian ice invasion and from stream activity during Sangamon time was to first fill the Deep Stage drainage-ways with sand and other debris to the level of the sand terraces found along both the present Scioto Valley and along that of the Ohio. Remnants of these are present north of Sciotoville, Ohio, and near Siloam Church, Kentucky. These terraces now stand at an elevation approximating 580 feet or 120 feet above the Deep Stage floor at 460 feet and 70 feet below the Teays level at 650 feet. Thus the work done during Sangamon time was comparatively small and was aggrading and not erosive.

The Wisconsin ice invasion which crossed the state, again caused some changes in the drainage patterns. The chief effect as far as the old waterways are concerned is relatively unimportant. Outwash of gravel and other sediments filled the valleys eroded in the Illinoian sand terraces to the flood plain terraces now standing at about 550 feet at Sciotoville.

In review of the evidence near Wheelersburg, practically all the work done in cutting the great valley now known as the Ohio was accomplished either in preglacial Teays time, before the Nebraskan glacier, or during the Deep Stage erosion cycle, that is Aftonian, following this early ice invasion. The Illinoian and Wisconsin glaciers enter little into the picture, their work being mainly aggrading.

RESULTS OF THE CHANGES

In this discussion, from these events the important things are:

- (1) The Illinoian glacier buried much of the Newark River of known Deep Stage time
- (2) It closed the Deep Stage outlet, that of the Cincinnati River.
- (3) It left a set of sand terraces below the drift border along what is now the Scioto and Ohio Rivers.

FURTHER CONSIDERATIONS AND ASSUMPTIONS

Now consider these facts:

(1) If the "fringe drift" in eastern Ohio is Illinoian then the Illinoian glacier inaugurated the Deep Stage drainage—by closing the Pittsburgh River—and after an interglacial period of at least hundreds of thousands if not millions of years—closed the same cycle by burying the Newark River and part of the Cincinnati. It would thus open and close a drainage period of very long duration. Impossible.

(2) On such an assumption if the "fringe drift" is Illinoian then it closed the Teays stage and again after a long, long period of erosion closed the Deep Stage. Impossible.

(3) Also if that eastern Ohio "fringe drift" is Illinoian then this ice sheet closed the three known water gaps, the Pittsburgh and Teays outlets of Teays time and the Cincinnati River outlet of Deep Stage time. No other outlets are known in the entire basin. Where did the water go?

(4) If the Illinoian drift of central Ohio and that of the "fringe drift" in eastern Ohio are of the same age then why is that in eastern Ohio profoundly weathered and that in central Ohio comparatively fresh?

CONCLUSIONS

When the age of the original streams, time of first stream disturbance, the immense amount of work done during the Deep Stage cycle, the severity of weathering of the "fringe drift" of eastern Ohio, the burial of the Deep Stage Newark River by known Illinoian drift, the closing of waterways, and other factors, are considered, the "fringe drift" of eastern Ohio cannot be younger in age than Kansan and from most of the evidence it is Nebraskan. Most assuredly it represents the oldest continental glacier in this region and cannot be Illinoian. In general those views are also held by others.³

LITTLE BEAVER CREEK

Since the age of the "fringe drift" in eastern Ohio is under consideration the data within Columbiana County should be duly appraised. Here much evidence is apparent and some of it is quite conclusive in fixing the time of glaciation and of the erosion cycles. (See *Wellsville* topographic sheet for references.)

As previously shown, the border of the "fringe drift" as it extends westward from Pennsylvania, enters Ohio in Section 25, Middleton Township, Columbiana County. From here the border is traced on westward by the village of Clarkson, then across Elk Run, Madison, and Center Townships, and past the villages of Dungannon and Kensington in Hanover Township to Section 36, Paris Township, Stark County. The trend of the moranic border is thus nearly east-west.

Next the original streams and their patterns should be considered carefully. The course and marks left by Negley Creek, a tributary of the old Pittsburgh River, can be identified with some assurance. This preglacial stream followed what is now the course of West Fork from Millport past Gavers to West Point. Some small shoulders of the old rock floor are evident at elevations near 975-980 feet. On eastward at Campus the floor of the preglacial Negley Creek is well preserved. Its elevation is not far from 972 feet. From Campus to Saint Clair much of the original stream bed has been obliterated by later erosion but sufficient remnants are left to mark the original course. Much the same condition is found north of Saint Clair where Negley Creek followed in what is now the valley of North Fork to Negley then eastward to the old Pittsburgh River. Supporting evidence for the course of the preglacial Negley Creek is provided by the direction of flow of Longs Run, Calcutta Run, Bieler Run, and many minor streams.

Now this preglacial stream, Negley Creek was blocked by the "fringe drift" just north of Saint Clair and hence the waters of this basin had to find a new passageway as an outlet. The course taken by the ponded waters was southward from Saint Clair along a small stream and over a col in Section 13, Saint Clair Township, to the headwaters of another small stream near Grimms Bridge. From here it traversed a winding course on to the newly formed Deep Stage master stream, the Pomeroy-Cincinnati River. (For a description of the valley from Saint Clair to Martins Ferry see Bulletin 28, Geological Survey of Ohio, pages 30-31.) This passageway is not a col but a gorge-like valley more than seven miles in length and from the rim of the highlands some 400 feet in depth. The new stream cut across the prominent Wellsville anticline and excavated its way through massive sandstones and other resistant rocks. Under any consideration the time required to do such an immense amount of work was long.

From the data afforded by the surface features in Columbiana County what are the facts revealed by these cycles of glaciation and drainage? The chief ones may be summarized as follows:

³See Wayne, William T., and Thornburg, William D.; Bull. No. 5, Geol. Survey of Indiana.

SUMMARY

1. The "fringe drift glacier" in this area blocked the northward passage of preglacial Negley Creek, tributary of the old Pittsburgh River.

2. The "fringe drift glacier" inaugurated the Deep Stage cycle of drainage and hence was responsible for the new stream and the deep gorge from Saint Clair to Martins Ferry.

3. This was no easy task for the gorge cut by this little stream is more than seven miles in length and some 400 feet in depth and was excavated across the Wellsville anticline and through resistant rocks.

4. The time required to cut such a passageway certainly required all of Aftonian time or it reached back to the Nebraskan glacier.

5. These occurrences all preceded the advent of the Illinoian glacier which later closed the Deep Stage erosion cycle.

6. From such data the "fringe drift" in eastern Ohio is Nebraskan. It cannot be Illinoian.
